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AUTHOR Moerk, Ernst L.
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ABSTRACT

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A Piagetian Functional Approach to Early Language Development

Ernst L. Moerk

Department of Psychology

California State University, Fresno

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Requests for reprints should be sent to Ernst L. Moerk, Department of Psychology, California State University, Fresno, Fresno, California 93740

Abstract

Piaget's research on the processes and products of cognitive and representational development in early childhood is employed to outline the bases of early language development. The processes of assimilation and accommodation, leading to horizontal decalage, empirical and reflective abstraction, resulting in schemas and schemes, as well as accommodative imitation and play, as sources of representation, are proposed to explain the infant's construction of cognitive and semantic base structures. Learning principles are added to this Piagetian account to explain the acquisition of a lexicon, transformations, and surface elements of specific languages. In this manner the developmental roots and the continuity of two basic cognitive and semantic structures, the Object-and-Attribute-Frame and the Human-Action-Frame, are sketched out. These are reflected in language as copula sentences and full-verb sentences, respectively. A survey of factual research on the relationships between cognitive and language development and a discussion of some philosophical and linguistic implications of the proposed model conclude the study.

A Piagetian functional approach to early language development

It is rapidly becoming a prevailing trend in the field of developmental psycholinguistics to search for cognitive antecedents to the first steps of language. This search has been performed in the Piagetian framework (Edwards, 1973; Moerk, 1975a; Morehead & Morehead, 1974; Sinclair, 1969, 1971, 1973) or more independently of it (Bloom, 1973; Bowerman, 1976; Bruner, 1974/5; Greenfield & Smith, 1976; Moerk, 1977b; Ryan, 1974). In addition to these more theoretical essays, several factual investigations have recently been performed on specific relationships between cognitive milestones and aspects of language mastery. These will be surveyed in a separate section of this essay. The common procedure followed in these latter studies is to employ parts of the Uzgiris and Hunt scales of cognitive development, to establish the child's standing on these subscales, and to relate his cognitive level to his linguistic level. The theoretical rationale for the selection of specific subscales is however rarely spelt out, sometimes absent, or derived from common sense assumptions. At the most, the rationale is derived from some of the above-mentioned theoretical discussions. These theoretical comparisons have, however, with very few exceptions (Aaronson, 1978; Moerk, 1975a, 1977b; Ryan, 1974; Moerk, Note 1) followed the older emphases of the Piagetian school and have been oriented towards antecedent cognitive conceptualizations or competencies and not so much towards the functions children employ in language acquisition.

Piaget's system and cognitive development more generally involve,

however, two aspects that could be classified as products and processes. This distinction was already made by H. Werner in 1937, who used the terms 'achievement and process'. A brief definition can therefore suffice: Under products are understood the concepts, patterns, and behaviors attained at the various levels of development. Products or the types of mastery attained are observed in overt behaviors either in testing situations or in natural observations. Under processes are understood those functions that enable the child to master the aliments derived from the environment and thereby to proceed to higher levels of development, that is, to higher achievements. In van den Daele's (1974) terminology, processes pertain to rules of transitions. Products are descriptive, whereas processes can contribute to the explanation of change. A more extended recent discussion of these two aspects can be found in Anderson (1976), who differentiated declarative knowledge (facts) and procedural knowledge (skills).

Though psycholinguists are at the present quite generally (see Aaronson, 1978) relying more upon a content orientation, three arguments suggest that a functional orientation would be more promising. The first is the explanatory power of functional explanations. The second pertains to the probability of obtaining generalizable results: As soon as any competence is multiply determined and can be reached over multiple paths, very few if any specific antecedent products will prove to be generally necessary for its attainment. Language, being mastered by children all over the world under the most diverse conditions, must quite obviously be attained following differing paths. Therefore, few strong and consistent relationships will be found between specific antecedent cognitive products and language mastery.

However, it is much more plausible that certain general processes need to have reached a specific level, before the child can advance to language mastery. The third reason is historical-epistemological: As Pascual-Leone (1976) has lucidly demonstrated, Piaget and the Piagetians have advanced from their structural/static approach in the fifties and early sixties to a process approach which has been refined and expanded during the last decade. The book of Inhelder, Sinclair, and Bovet (1974) is the most obvious and outstanding example of this newer functional approach, which concentrates upon the explanation of transitions and not only upon the descriptions of stages. In contrast to these advances of the Piagetian school, the Uzgiris-Hunt (1975) scales, being derived from older conceptualizations and aiming mainly at the ascertainment of levels of cognitive development, measure predominantly products of the developmental process and not the processes leading to them. In this respect, the scales share the weakness of most intelligence tests: Specific knowledge or behavior patterns may be dependent upon equally specific environmental influences. Such tests are therefore less dependable predictors of skills that are qualitatively different and may depend upon other types of environmental inputs. Insofar as the cognitive products measured by the Uzgiris-Hunt scales and language mastery are dependent upon different environmental inputs, meaningful predictions about the level of correlations between both sets of variables are impossible as long as the environments in which the children grow up are not known. The way psycholinguists have employed the Uzgiris-Hunt scales also seems to contrast with Uzgiris' own clearly expressed attitude, who warns that "it would be unfortunate if the present interest in Piaget's theory would lead to the borrowing of a few of his tasks as test items..." (Uzgiris, 1976, p.4). To counter

this danger she emphasizes "the issue of selecting questions for study" for which "a theoretical perspective is of greatest value..." (Uzgiris, 1976, p.8).

The Goals of the Study

The overall goal is to employ the best developed and most comprehensive system of cognitive development, that of Piaget, and utilize it in an encompassing and systematic manner to provide a theoretical perspective of communicative development from birth to the beginning of more-word sentences. As a counterweight to the recent emphasis on cognitive products and their possible relevance for language development, processes and mechanisms that lead to transitions from lower to higher stages are stressed. In this endeavor previous outlines of process-related cognitive/communicative developments (Moerk, 1975a, 1976, 1977b, Note 2) will be utilized and expanded upon. For the models to be proposed, the conceptual analyses by van den Daele (1974), Flavell (1972), Flavell and Wohlwill (1969) and also the recent challenging work of Inhelder, Sinclair, and Bovet (1974) have proven very valuable.

Besides sketching out an hypothetical outline of the sequences of cognitive/communicative development, a statistical methodology, that of path analysis, is suggested for the evaluation of the suggested hypotheses. Path analysis, being derived from economic research, has been theoretically developed by Wright (1960a, 1960b) and applied to social science research by Duncan (1966), Duncan, Featherman, and Duncan (1972), and Heise (1969). Anderson and Evans (1974) provided a lucid exposition of its application to educational research. Path coefficients, which express the amount of change in a 'dependent variable' that is due to a change in

an antecedent variable, can be computed from correlation coefficients and are similar to standardized regression coefficients. If the variables are arranged in a path diagram with the path coefficients, a causal model is presented expressing quantitatively the linear, additive, and asymmetric relationships among the set of variables. Since some correlational data have already been reported in studies to be discussed below, and since additional data can be quite easily collected, the full evaluation of the hypothesized causal model needs only to be temporally delayed.

As a preliminary attempt toward evaluation, recent investigations that are pertinent to the present model will be briefly surveyed in another major section of this study. Correlational as well as longitudinal data will be employed in this process in order to approximate as closely as possible both the quantitative as well as the sequential aspect of the model.

In the concluding section, possible implications of the model for psychological, philosophical, and linguistic formulations will be considered. The suggested two basic frames that seem to underly human perception, behavior, thought, and speech do not appear to be in close accord with the old emphasis upon an undifferentiated form of predication with its arguments as the basic principle of thought and language. If the suggested hypotheses are supported, they would throw a new light upon century-old controversies about the nature of the sentence and they would require revisions of some linguistic outlines of case grammars and semantic roles.

Methodological Considerations

In order to be able to justifiedly expect sizeable relationships between cognitive and language attainments, special care has to be taken in the selection of both types of variables.

a) Antecedent cognitive developments that can be expected to be related to language acquisition: The ideal approach would be to measure functional aspects that are prerequisites for both cognitive and linguistic advances. The suggested emphasis upon the processes of assimilation, accommodation, simple and reflective abstraction, imitation, and finally upon a variety of learning processes partially approximates this ideal. As far as factual studies are concerned, the problem is however encountered, that few or no standardized instruments exist to measure processes. Experimental investigations would be needed to attain this goal. The problem is however more profound than the mere absence of measurement technologies. Even the best known of these processes, such as learning and imitation, are quite unsatisfactorily conceptualized. This lack of definiteness is perhaps even more acute in respect to Piaget's process-related concepts.

A second approach can build upon the logical dependency of messages upon the conceptualizations encoded in them. Specific concepts and ideas certainly have to be formed first before they can be encoded in a message. Therefore they constitute necessary though certainly not sufficient antecedents of language. When accepting the additional assumptions that parents provide an 'optimal match' (Hunt, 1965), that is, they stimulate the child to encode verbally his concepts as soon as they notice he has mastered them, considerable correlations can be expected. The latter assumption has recently been supported by several studies, such as Moerk (1974, 1975b, 1976) and Snow (1977). Which specific concepts can meaningfully be assumed as antecedents of verbal products depends, of course, upon the specification of the dependent variables.

b) The dependent variables as encountered in the earliest speech of children. Only the barest outlines of functional analyses of language have

been made. Solely the process of representation has been shown by Piaget and many others to appear in the problem solving behavior of infants before they have mastered speech and to be of utmost importance also in the acquisition of language. This process will therefore be specially emphasized in the following discussions. Imitation is likewise implicated in the acquisition of both nonverbal and verbal skills. Its functions and contributions will also be emphasized. Much more thought and research has been invested in the linguistic descriptions of the grammatical and semantic aspects of language. These two aspects and their pragmatic import will therefore be considered most closely. Morphological acquisitions however appear generally only at somewhat later stages. Therefore they are not included in the present analysis.

Independent of whether linguists report semantic/syntactic analyses of Indogermanic languages or whether developmental psycholinguists report on the first stages in child speech, two basic function-meaning-form complexes stand out. The one centers around the labeling and description of objects and the other complex around the description of actions or processes. Although the elements pertaining to both these complexes are encoded with varying degrees of detail, the basic complex or structure remains the same. The roots for this dichotomy seem to go very deep. Such a double perspective of the world is already reflected in Democritus' emphasis upon atoms and things versus Heraclitus' fascination with continuing change and dynamics. It is still encountered in Russell's attempts at Analysis of Matter (1927) versus Brentano's and Husserl's act philosophy. In psychology, this basic contrast is reflected on the one hand in the two basic elements of classical learning psychology: the 'stimulus' versus the 'response'. On the other hand, the Gestalt and other perceptually oriented schools as

contrasted to the behavioristic school reflect a similar contrast. More specifically for developmental psycholinguists, from Wundt over Binet, Guillaume, and K. Buhler to Werner and Kaplan (1963) and Braine and Wells (1978), psychologists have discussed evidence pertaining to two basic sentence structures, which will be termed here the Object-and-Attribute-Frame and the Human-Action-Frame. In English and many Indogermanic languages these two frames are rendered as copula sentences and sentences with intransitive and transitive verbs, respectively. Pike and Pike (1977) present evidence that the same dichotomy may be more general, since it is found in languages completely unrelated to the Indogermanic Language family. In child speech, the Object-and-Attribute-Frame is encountered in its simplest form as This is ...., whereby the deictic element is often conveyed nonverbally. The result is the broadly discussed and very frequent phenomenon of labeling. Somewhat later more complex forms appear, such as the structure: X (a specifically labeled object) is Y (a specified attribute). This structure contains a double predication; the first one reflecting the classification: 'The X is such that X is a .....', and the second referring to the additional (mostly nonfocal) attribute. In logic this is the feature of multiplication of classes. Since a label normally is not applied on the basis of the differentiation of only one feature but on the basis of 'perceptual coherence' (Gurtwitsch, 1973), the equational sentence X is Y involves multiple classifications: several core features as bases of the label and an incidental feature as basis of the predicative adjective.

The Human-Action-Frame is encountered in two major forms: sentences with intransitive and transitive verbs. This subdivision is known from the the literature as 'intransitivity' versus 'transitivity' and was recently

analyzed from a developmental perspective by Ingram (1971) and Wall (1974).

The term 'frame' as employed in the above two descriptive labels is used in the sense of Goffman's (1974) frame analysis. The concept frame refers to underlying meaningful structures, standards, or 'frames' that force patterns upon our organization of experience and behavior. Often all specific items of the pattern can be substituted, so that the original pattern is not easily recognized. In the field of linguistics, similar conceptualizations were formulated by Saussure, Jesperson, Bloomfield, Hockett, and recently again by Hymes. The psychological reader will recognize related concepts in Piaget's concept of schemas and schemes and the Gestalten of the Gestalt school.

With the stipulation of these two basic structures, which are seen as functional-semantic-structural bases of much of later language activity, the looked for conceptual antecedents are also implied: They are objects and their attributes, processes and activities with their entailed agents and recipients, and at later stages the spatial and temporal coordinates in which objects and actions are arranged. Two important disclaimers, however, have to be immediately added: First, it is not seen as relevant whether the young child conceives of objects as permanent or not. Whereas the detailed rationale for this approach will be given in the discussion of the development of the Object-and Attribute-Frame, the basic argument is simple. The speaker names only concepts or experiences and not the referents themselves, as spelled out in many philosophical/linguistic analyses from Aristotle to the present. Concepts and experiences are evoked and vanish; they are therefore in principle non-permanent. As research on infant attention and in many fields of human experience demonstrates, concepts and experiences can pertain to extremely fleeting phenomena. Many of

them are remembered, that is, represented and therefore in principle can be labeled.

A clarification is also needed regarding the term action as used in the heading the Human-Action-Frame. It is proposed here that the behavioristically influenced assumption that actions have to consist of overt motor movements is unjustified. In contrast, it is propounded that language is not conceived from an outside (behavioristic) perspective but from an inside (mentalistic/cognitive) perspective. That is, the sender expresses his conceptualization/experience and not what others may observe. Since language was invented long before the 1920-ies, a behavioristically conceptualizalized straight-jacket is illfitting for it in many aspects. Such a behavioristic approach however is reflected in the differentiation, made by linguists and psycholinguists alike, of main verbs into action verbs and state verbs. According to this distinction verbs such as to want, to see, to hear and many similar terms describing internal processes would be states and not actions. In contrast to this, it is here asserted that the fact of profoundly wanting something is much more dynamically experienced than, for example, the fact of semi-automatic locomotion. Without engaging in quite intensive processes of acoustic and visual analysis (that is 'action') the incoming information could not be incorporated. If seeing is a state, then what is reading? And which reader would not interpret reading as a very demanding, dynamic, and often tiresome activity?

The answer to these rhetorical questions has been provided a long time ago. Brentano's act psychology, Freud's discussions of the infant's belief in his 'omnipotence', Werner's (1940) evidence from ethnography about the power imputed to looking and listening, and much common sense experience

suggest that perception and desires are experienced on a more primitive (or more sophisticated, if compared to rigid behaviorism) level as very active and dynamic processes. Especially in the case of the infant, comprehension consists of real comprehendere in the Latin meaning of the word, that is exploring and handling. Infants do not only 'hear', but 'listen' intently, as demonstrated by changes in their heart rate after even simple auditory stimulation. Seeing and watching can consume their entire attention. Motoric action is only a very special, common, and therefore prototypical (in Rosch's (1973) sense) feature of some of these active processes. This feature, however, has lead to the definition of the entire class in recent postbehavioristic writings. The inventors and perpretators of language, however, were not mislead by this superficial distinction. As Chafe (1970, p. 347) reports: "the experiencer relation quite generally falls together postsemantically with the agent relation, having the same surface structure representation in most if not all languages." Preschool children appear to have the same conceptualization. In a recent study by Braine and Wells (1978), the children predominantly put the experiencer under the category of agents in spite of the fact that the authors had chosen an extremely unfitting example for experiencer: The elephant is feeling the tack, with an unhappily grimacing elephant sitting on a tack. Which child would in the same situation ever say I am feeling the tack? The only reasonable description of this situation is: The tack pricks/hurts me/the elephant. Therefore it is no wonder that a minority of the children associated the elephant with the grammatical object, when responding to the picture.

c) The relationships between the two sets of variables. After the dependent variables have been described and their logically entailed concep-

tual antecedents have been specified, the last important question can be broached concerning the relationships between the two sets of variables. Cognition could determine language acquisition and behavior, language could determine cognition, and a reciprocal bidirectional interaction could exist between the two. Though it is assumed that all three types of relationships exist, and though the interrelationships between both sets of variables will be presented in the main two tables to follow, in accordance with the goals of this essay, the effect of cognition upon language development will only be dwelt upon. This effect can be direct, indirect, or both types of effects can be combined.

In an assumed cause-effect relationship, the cause of course has to precede temporally the effect. This means that in the present analysis the effects of preceding cognitive achievements upon subsequent steps in language mastery should be analyzed. Time-lag comparisons are therefore the optimal means to study this relationship, if only or mainly qualitative aspects are studied. If both sets of variables are quantitative and their increase is a function of age/experience, correlational analyses obtained from simultaneous measurements are theoretically justifiable as close approximations to time-lag comparisons. The longer the intervals between times of measurement, the more the analyses will have to build upon this latter approach. Since the subdivision of the sensorimotor stage into six substages, as presented by Piaget, involves considerable intervals, studies employing the latter analysis will have to be utilized in the evaluation of the presented model. Longitudinal detailed analyses, however, remain the method of choice.

A last theoretical question in respect to the temporal relationships between the two sets of variables pertains to the level of cognitive development that is assumed to suffice for the subsequent establishment of a lin-

guistic skill. Piaget has insistently and consistently emphasized the continuity of development, so that one specific scheme appears in rudimentary form one or two substages before its full establishment and that it is further refined and expanded upon even after its establishment. His most basic concepts, assimilation and accommodation, reflect this outlook. Though this question of developmental sufficiency can not be answered theoretically and will have to await factual research, its consideration is important for the evaluation of the cognition-language relationship and also for the design of the two tables in this essay.

Since it has to be assumed, and this assumption is incorporated in the tables, that specific steps in language development can be reached in various ways, no specific level of any cognitive antecedent should be a necessary prerequisite for their attainment. Instead, a compensatory relationship is postulated, such that a combination of two or more variables, a + b + ..., leads to the attainment of z, whereby the values of a and b, etc. could vary over a wide range. If the child receives more enrichment in a, his mastery of b could be relatively low and still suffice for the attainment of a specific linguistic level, z, which would require for another child a much higher level in b, if the level of a is low. In addition, as it will be reflected in the design of the tables, various processes are seen as necessary for the transition to higher levels. If these processes can not be engaged in, even high levels of necessary prerequisite products should be of no avail for the attainment of the next qualitative level.

Such a design, including individual developmental differences, multidetermination, and substitutability of alternate courses, incurs the danger of resulting in a model that is too strong, so that it can not be disproved by any one experiment. It also implies a network of relationships wherein even

supportive findings will not look very convincing, if obtained from larger numbers of subjects. Idiosyncratic courses of development will lower the strength of the overall relationships observed in groups. Since the model is multivariate and development is overdetermined, the amount of variance being accounted for by single variables can not be expected to be very high. Neither will strict laws of developmental dependency be found and predominant trends or "tendency laws", as Kaplan (1964) labeled such relationships, will have to suffice. Results from individual subjects, who by definition would have followed their partly idiosyncratic courses, and from small samples, which may deviate from the predominant trend, would be expected to sometimes differ from the "tendency laws." Such findings nevertheless would not necessarily cast doubt on the model presented nor on the methodology employed in the studies, as long as the "tendency laws" can be recapitulated. Since cause-effect relationships are postulated, no inversions of sequential orders in the strict sense however would be expected.

The Development of the Object-and-Attribute Frame, the Human-Action Frame, and their Constituent Elements.

First the overall design will be discussed as it pertains to both frames and to Tables 1 and 2. Then the development of each frame as represented separately in the tables will be explicated in somewhat more detail.

The Design of the Tables

The overall design of the tables is based upon developmental levels, horizontal decalage being summarized in the rows and vertical decalage in the columns. In this manner, both basic aspects of development, the quantitative increase in complexity, that is horizontal decalage, and qualitative epigenesis, that is vertical decalage, can be encompassed. On the horizontal dimen-

sion, Piaget's six stages of sensorimotor development are differentiated together with a very preliminary and global description of the preoperational phase. On the vertical, epigenetic dimension, four major levels, those of perception and behavior, schemas and schemes, meaning and representation, and referential communication, are differantiated for each stage. In accordance with the advocated emphasis upon developmental processes, the main developmental functions that lead to progress from lower to higher levels are specified in the body of the tables. They are, beginning on the lowest level: assimilation and accommodation; to this are added simple (empirical) and reflective abstraction that lead to the cognitive level, accommodative imitation and recognitory abstraction plus ludic assimilation as the source of the semantic/representational level, and finally processes of learning in the traditional sense as the basis for the mastery of the transformational and surface features of language. Whereas the fact that the higher processes and functions are superimposed upon the lower ones is clearly represented in the design of the tables, one potentially misleading interpretation has to be guarded against: It is not intended to suggest that the lower-level functions are lost, when the higher ones appear. In contrast, they contribute importantly to development throughout the entire life span. This continuity is suggested by the horizontal insertion of the functions, that is, they are parallel to the age axis and could never reach a zero point. Accordingly, aliments from the environment have to be processed on various levels, whatever the age of the child may be. They have, so to speak, to proceed through various filters of functions in order to reach the levels of meaning and to be encoded linguistically. It is therefore fully acknowledged that language learning and linguistic processes involve a large variety of processes: equilibration with the environment is the most basic one and is supplemented

by abstractions, representations, and finally by rote and rule learning.

In the cells of the tables are described the specific products that have been attained by children who were observed by Piaget and by researchers on language development. Whenever a specific cell may be controversial, it is discussed below in connection with the analysis of the development of the pertinent basic frame. Generally, however, it is assumed that the developmental steps belong to the common and established pool of knowledge and no specific sources to factually support the items are given. Most of the pertinent evidence can be found in Piaget's writings. The competencies are presented in the tables, when they have been reported to appear earliest. It is assumed that they will be retained and will continue to appear at later periods. Since very few complete substitutions of behavior, concepts, or processes are found in the course of development, this continuity can almost be taken for granted.

The most important, least demonstrated, and most challenging aspect of the tables are the arrows. They represent the first step to the final goal of path-analysis, that is, the specification of the causal antecedents, transitory steps, and multiple paths to language development. The horizontal and diagonal unidirectional arrows represent the postulated 'sequential effects', to use Flavell's (1972) terminology, and the vertical, bidirectional arrows represent what Flavell called 'reciprocal, bidirectional effects' (Flavell, 1972, p. 282 and 284). This design does not only emphasize the continuity of development, it also suggests its flexibility. A closer study of the tables will reveal that, with the exception of the first items of each qualitative level, each product as described in a cell could be reached from four different directions: from the qualitatively lower level of the previous period, from the qualitatively lower level of the same period, from

the qualitatively identical level of the previous period, and even from the qualitatively higher level of the same period. Though it is assumed that all four paths will be normally combined in the attainment of each specific competence, considerable individual and environmental variation can be accounted for in this design. Nevertheless, the thereby presented hypothesis is not so vague as to be untestable. In accordance with the design, it is assumed that in larger samples the relations between neighboring cells will be stronger than those between more distant ones. In individual cases who have reached any higher level, a complementarity would be expected: If one of the possible antecedents is not or only minimally developed, one or several of the others are expected to be better developed than in the average child. Both large-sample correlational methods as well as idiographic longitudinal analyses therefore can be applied in the evaluation of the tables. In the second to the last section of this essay both types of evidence will be surveyed for a preliminary appraisal of the suggested design.

Delimitations of the Tables:

Though only partially justifiable on theoretical and biological grounds, the tables encompass only a time span from birth to the beginning of the preoperational period. Following Piaget's lead, the first two years are analyzed in detail, since the most profound developments appear to be proceeding during this stage. For the preoperational period, only a very rough characterization is provided. For this stage, a much more detailed analysis has to be worked out at some future time, especially since this is the time when verbal skills *per se* are acquired at the fastest rate. Also on the dimension of the vertical decalage, a somewhat arbitrary cut-off point had to be chosen; this is the level of language performance, since it is of greatest interest in the present context. In the discussion section, however it will be sketched

out how development proceeds to levels of metalanguage.

Another arbitrary cut-off point has to be briefly mentioned and partly qualified. Point zero of the tables was chosen with birth and with perception/behavior appearing at this time. This is obviously not true to reality: the embryo and fetus lives nine months before this period. At least parts of his sensorium are functional since around seven months before birth, and responses to stimuli can be elicited since around six months before birth on. Neither is perception and behavior, as commonly defined, the lowest level of (re)/activity. On a lower level of physiological adaptation, stimulus input is effective without resulting in perception. Furthermore, the fetus engages quite often in athetotic and reflex movements during his prenatal life, which certainly are qualitatively different from what normally is called 'behavior'. Under 'behavior' being understood in this context motor activity that has a clear onset, an end, and has the quality of intentionality.

The above discussion regarding the arbitrariness of the zero point is directly relevant for the design of the tables and the thereby presented hypotheses of cognitive-communicative development. In accordance with general psychological experience and theoretical interpretation, it was assumed, when constructing the tables, that higher levels appear temporally later than lower levels. This is reflected in regard to levels 3 and 4, the semantic/representational and referential/linguistic level. In contrast, levels 1 and 2 both contain some products already in the stage of reflexes. This presentation is based upon the assumption that the product on the cognitive level appearing in the stage of reflexes is a result of prenatal experience. Though it is not often discussed, considerable evidence of learning before birth (Spelt, 1948; Gottlieb, 1976) and immediately after birth (Sameroff, 1971) exists. Therefore it would not be justified to assume that six to

seven months' of experience would not have left any traces in the very early developed brain of the fetus.

The Object-and-Attribute Frame

Row 1 of the matrix, encompassing perceptions and behavior, is a brief rendering of those Piagetian descriptions of the substages of sensorimotor and preoperational development that are most relevant to the development of an extensive experience with objects.

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Insert Table 1 about here

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Row 2, pertaining to schemas and schemes, represents again in its main aspects Piagetian conceptualizations but also some deviations from Piaget and a quite profound contrast to most of the recent applications of Piaget's system to the understanding of language development: In cell 1 of the row, the item Substance suggests that already at the moment of birth or probably even before the child has a protoconcept of the fact that things have mass. This protoconcept could be derived from around 30 weeks of experience (from the beginning of the functioning of the sense organs until birth) with the restraining functions of the womb, the impact of moving limbs, and experience with hand or finger sucking. It could and probably does have strong innate components too. Evidence for such a protoconcept is found in the neonate's behavior such as the grasping reflex, hand-to-mouth movements plus thumb sucking, the rooting reflex, and in Bower's (1971) extensive research on even neonates' reactions to objects that appear to approach. Through the infant's experience with objects by means of his perinatal schemas, a concept of objects develops, which, in contrast to the early awareness of mass only, incorporates more advanced delimitations, i.e., primitive Gestalt

qualities. The intended contrast between Substance and Object could be best exemplified by the contrast between amorphous sand versus a sand pie. Substance without a specific object must be experienced by infants who are tightly swaddled. For the early establishment of an object concept hand and mouth are probably essential. This object concept is then refined. Features, and thereby a variety of objects are differentiated, and objects are related to each other through the interplay of assimilation and accommodation. In this analysis, Piaget's emphasis upon object permanence is disregarded as far as the development of the Object-and-Attribute Frame is concerned. It is argued that the recent emphasis upon object permanence as an antecedent of language (Corrigan, 1978; Carter, Note 3) is illadvised and reflects an adultomorphic perspective which is illfitted for the early stages of child development. Permanence, as contrasted to recognition, is an almost irrelevant aspect for the infant's early mastery of his surroundings and it is even more irrelevant for his early vocabulary. Not only has mankind had the habit of labeling non-substantive and fleeting phenomena such as the twilight, the rainbow, or lightening, but the child will learn to freely label ghosts, gods, and fairies, astronomical phenomena, and many drawings or pictures without much concern about their substantiality or permanence. The tying of object permanence and labeling appears to have its root in the now obsolete referential theory of meaning, that is, that words have to have a referent. In contrast, philosophical, linguistic, and psychological analysis from Aristotle to Leibnitz, Ch. Morris (1938), Broeker & Lohman (1948), and the psychologist K. Buhler (1934) has proven convincingly that not referents but experiences or conceptualizations are labeled. Experiences are per definition only brief and not permanent. More in a developmental perspective, it could be argued that for the infant and young child

many important objects seem to be non-permanent, such as his food items, which are dished out for him and have discontinued their existence after the meal (at least as far as the child can be aware of the facts), his visiting grandparents, whom he may not see for months between visits, etc. Furthermore, during the first year, a large percentage of visually known objects also may lack substance for the infant. This applies to everything that is consistently out of his reach. In accordance with the above argument, it is commonly reported that some of the first words of children express emotional reactions to food etc., wishes and demands, and other fleeting psychological experiences. It is therefore contended that the infant needs only a delimitated experience to be able to attach a label to it. Whether he thinks, or knows, or incorrectly believes that these 'objects' (such as his mirror image, or later the imaginary playmate) are substantial or permanent is quite irrelevant. These phenomena however are highly relevant for the language instruction by the child's environment. Parents can only attach a label to a child's experience, when they have some independent evidence that the child has this experience. Much, though by far not all of this evidence, is provided when the child plays with, points to, and explores objects. A brief glance at many diary studies, can serve to convince any skeptical reader that, besides labels for well-known objects, labels for the moon -- whose substantivity the infant can not know -- for passing phenomena such as sounds, and other visual experiences without any substantive component form a considerable part of the early vocabulary. The first word of the writer's own child was, for example, "lighty"; a label for the light plus shade on the ceiling, whose substantivity the child had never experienced. The switching on and off of the light however had attracted the attention of the child (cf. Kagan's (1970) research on change as a source of attention), and the parents had used

this evidence of attention to attach a label to the experience. Since the label was learned in connection with the on- and off-switching of the light, it is related to an 'object' which the child knew only as non-permanent. One of K's first adjectives was finster (= dark), uttered after the light was switched off. Was hereby the meaning defined through non-existence?

The above argument is partly in accord with and partly an answer to Kagan's (1964, p. 172) perceptive remark: "The nouns uttered by A. include tiger, eye, and cake, and my intuition rebels somewhat at the assumption that the "thingness" of these objects is a basic source of communality among them." Neither can it be permanence, since the cake is by its function non-permanent (for the child) and about the tiger's thingness or permanence the child can not know.

Regarding row 3, the table again fully follows Piaget's descriptions, with those aspects being selected that are most important for the establishment of the Object-and-Attribute Frame. The general understanding that stimuli stand for something, the association of specific signifiers with signifieds, the internal evoking of a signifier for an absent event and the intentional communicational use of signifiers are sketched out. These signifiers can be stimuli emanating from objects, the child's own behavior, images, or even objects standing for other objects in pretense play. Regarding the final level in row 4, evidence from reports on language development and preverbal communicational development is summarized. Though this evidence is in congruence with Piaget's reports, most of it stems from other sources, since Piaget dealt only incidentally with language development. The inclusion of an aspect of preverbal communication with Reference and Language has to be clarified.

If 'communication' is defined, in accordance with common usage, as the

intentional conveying of messages about representations of objects and relations (in Buhler's (1934) terminology), then it is encountered already in intentional and referential pointing. Whether it is this pointing alone, or the 'vocal gesture' described by older developmental psycholinguists, which has recently been rediscovered by Carter (Note 3) as 'sensorimotor morpheme', or the first conventional word, which is often onomatopoetic, that is, analogically representative, all four elements of the communicative situation are present: the referent (concept), the message, the sender and the receiver. Intentional referential pointing therefore is included in row 4 as one aspect of the developing semiotic competence. This is especially obvious in the case of the 'vocal gesture': both the act of referring and that of using a somewhat arbitrary sound pattern in doing it are present.

To summarize Table 1 and the development of the Object-and-Attribute Frame: The basis of this frame lies in the sensory system of man and thereby in the orienting response and the attentional reactions. These processes of information intake lead by means of figurative (empirical) and reflective abstraction to cognitive schemas and schemes. From this basis, accommodative imitations and recognitory plus ludic assimilation lead to representations, which in turn form the semantic base for intentional referential communication. The informational element, or 'predication', which was first the result of the orienting response, is later encountered on the verbal level in labeling and in a refined form as the deictic copula sentence "This is ...". The orienting being equivalent to the deictic element and the information intake being equivalent to the predication or label. With the differentiation of several features of each object, the child will produce sentences containing multiple predi-

cations: X is .... (red, big, etc.), which is, as argued above, an intersection of classes: X such that X belongs to the classes of a, b, c and also to the class of red or big things. Sentences such as A dog is an animal follow the same principle, with the two classes standing in a relationship of superordinate and subordinate.

Since it is impossible at this place to present in detail the developments and transitions that are suggested in the table, a very similar design in E. Gibson's (1969) book (Figure 8-4, p. 161) and a more extended discussion of these developmental paths by Moerk (1977b) may be compared for more intensive analyses. The parallels between Table 1 and Gibson's (1969) Figure 8-4, which was discovered long after the present model had been developed, are so close as to extend even to hypotheses about prenatal learning, the reciprocal bidirectional processes, and very specific sequences on the various levels of vertical decalage. Since Gibson dealt almost exclusively with perceptual learning, and since the Object-and-Attribute Frame is intended to represent perceptual learning and communication about the world of objects, these parallels represent an encouraging support of the presented developmental hypotheses.

Finally and perhaps most importantly the arrows of the table have to be considered. They present the assumed network of causal paths leading to higher levels generally and to language mastery specifically. At present these arrows reflect only the reported temporal sequences of development. Whether the stronger causal hypothesis can be supported, that post hoc reflects also propter hoc, will have to be investigated through the study of individual and group differences in the courses of behavioral/cognitive/communicative development. Both natural experiments as constituted by social and cultural differences and training experiments can serve

this purpose. Conceptually important are the multiple paths leading from one cell to any other. The further specific cells are separate from each other the larger the variety of paths are which lead from one to the other. It has to be reemphasized that the processes that serve the transition from lower to higher levels are seen as necessary prerequisites for vertical advances. The products described in the cells of the matrix are seen as necessary only insofar that some of the antecedent levels have to be attained, though not all of them need to be fully mastered. They are certainly not assumed as being sufficient for progress to higher levels. None of the processes is hypothesized as dispensable, whereas some of the products could be only minimally present or perhaps even completely absent.

The Human-Action Frame

The development of the second basic frame upon which a large percentage of linguistic utterances are built is presented in Table 2.

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Insert Table 2 about here

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Most of these developments are well known from Piaget's and others' descriptions and therefore need not be enumerated here. The infant, being born with reflexes and athetotic movements, encounters objects in his environment and shapes his movements into actions. This Piaget has discussed under the term circular reactions. Assimilations lead to generalizations of actions to new objects; accommodations lead to differentiations of action schemes; and a combination of both leads to the expansion and intercoordination of action schemes as Piaget described it, labeling this phenomenon horizontal decalage.

Simple or empirical and reflective abstraction are the processes which produce schemas and schemes on the cognitive level. On this level, the hypothesis of a scheme of 'movement' in stage 1 is not in accordance with Piaget's reports. This item serves to refer to the fact that already the fetus and infant at birth has experience with movements, athetotic and reflexive ones. These experiences, which date from 12 weeks after conception, must have left some traces in the brain at stage 1, that is after around 30 weeks. The next steps on this level are derived directly from Piaget's descriptions of the infants' sensorimotor and intellectual development, as can be seen from a comparison of rows 1 and 2 of Table 2. The difference between 'movement' of stage 1 and 'action' of stage 2 is conceived in a manner parallel to that between 'substance' and 'object' in Table 1. 'Actions' are seen as having a clear beginning and an end, an overall unitary pattern, and systematic relationships between elements, that is Gestalt qualities. As suggested by the diagonal arrow going from row 1 Stage 1 to row 2 Stage 2, this formation of a category of actions is assumed to be shaped by the neonate's use of reflexes, especially the grasping reflex and the orienting reflex, which have Gestalt qualities in contrast to athetotic movements. The 'handling', whether motorically or perceptually, of many objects, experiences of needs and desires and the consequent actions lead to the differentiation of many types of 'actions' in the broad sense discussed above. Later, other elements of the extended action-scheme are becoming distinct. These are the objects of actions, the agents of actions, and spatial and temporal relations between actions. Such an extended and differentiated action scheme on the cognitive level anticipates the semantic structures of non-verbal and verbal messages. It shall again be emphasized that under the

word 'action' a much broader concept is encompassed that would be better conveyed by the term 'process'. A clearly differentiated wish, perceptive act, or emotional reaction would fall under this concept.

On level 3, that of Meaning and Representation, the development proceeds from comprehension to reproductive imitation, to representative imitation, and finally to new and productive representation. Whereas comprehension of signifier-signified relationships on the lowest level is probably based upon processes of association, internalized imitation as described in detail by Furth (1968) is one of the processes important during the sensorimotor period for the establishment of representations. The more the child reestablishes an equilibrium between accommodation and assimilation, the more his representation will become spontaneous and productive. The process labeled in the table ludic assimilation expresses this more advanced aspect of the child's representative functioning, wherein the child can flexibly evoke representational schemes and utilize them for communicative or ludic purposes. In this process, the principle of verbal communication is anticipated very closely: The child conceives of a structure, such as the doll sleeping in a bed or the cat walking on a fence, and quite freely substitutes the elements of this structure. A stone can represent the cat and any straight line the fence. The main difference to language is that these substitutions are still based upon the principle of similarity, i.e., they are still analogical. In language these elements are, or at least can be, completely arbitrary.

On the referential and verbal level, the principle of horizontal decalage can be observed too. The infant first comprehends the meaning of maternal gestures, evolves then complex preverbal communication rou-

tines as described by Bruner (1974/75) and Harding & Golinkoff (Note 4) at the time when he also understands verbal commands, that is in Stage 4. Around one year of age, infants begin using single words, which can be verbs or particles, the 'performatives' of Bates (1976), to convey messages about desired actions. Finally this simple schema is differentiated and other elements are clearly distinguished and labeled separately in a gradual approximation to the more-word structure of sentences with full verbs. This structure can be expanded by means of prepositional phrases dealing with spatial, temporal, and other aspects of the process to be described.

A next level which is reached relatively late is that pertaining to an awareness of grammatical rules underlying speech. As a consequence of inserting a considerable variety of elements in the agent-action-and object slots of the Human-Action Frame, the pattern becomes abstracted from the specific semantic relations wherefrom it originated and becomes the syntactic subject-full verb-object frame.

Factual Evidence for the Cognitive/Communicational Developmental Sequences as Described in Both Tables.

In one sense the evidence for the presented developments is very rich. The tables themselves are a result of the systematic arrangement of this evidence, as it was reported by Piaget and by many authors studying the earliest stages of human development. The evidence from these sources has however one profound weakness. Cognitive and communicative data often are not derived from the same children; instead of exact temporal sequences observed in longitudinal studies of individual children or at least correlations from larger samples, only an overall sequential design can be derived from these reports. An exception are Piaget's relatively detailed

descriptions of the developments of his own children. Since Piaget reported behavioral, cognitive, and communicational developments, his protocols can partly be used for a preliminary evaluation of the tables. The problem with this approach is however that it would partly entail a circular argument. First, the tables were designed on the basis of Piaget's descriptions and then they would be evaluated by means of the same data. Mitigating circumstances would be that Piaget's findings were closely replicated in a large number of studies and that identical data on language development already had been obtained long before Piaget and independently of him also after his publications.

A few studies however have been performed during the last few years that permit an independent even if only partial evaluation of the present hypotheses. Since most of these studies were designed or at least published after the present tables have been presented at a conference (Moerk, Note 1), hypotheses and evaluation are certainly independent of each other.

Bates, Benigni, Bretherton, Camaioni, & Volterra (Note 5) have presented the largest assortment of correlational data that are closely pertinent to the present hypotheses. They studied children ranging in age from 8 to around 13 months, employed parts of the Uzgiris-Hunt scales of sensorimotor and cognitive development, and collected observational and interview information on the children's symbolic and verbal mastery. Their subject sample covered therefore only a narrower age range than the present tables and their sample of assumed antecedents overlaps only partly with the present hypotheses. Wherever there is an overlap, their data can without major reinterpretations be employed for the evaluation of aspects of the present model. Since Bates et al. did not differentiate the

two basic frames presented in Tables 1 and 2, their correlations fit partially both tables and are presented only once.

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Insert Table 3 about here

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Bates et al. presented only the significant correlations and data about the percentage of correlations that reached significance. The latter are presented in Table 3. The minimal value of a correlation to be significant at the .05 level is .344. Most of the correlations reported fell into the range of .35 to .55, which means that around 15 to 30 percent of the variance in a subsequent variable are accounted for by a preceding one, if the two are significantly correlated. A comparison of Table 3 with Tables 1 and 2 shows that Bates et al.'s findings support to a considerable degree the assumed developmental trends. Items on the same level of vertical decalage are most often significantly correlated. The nine language measures attain significance in 44 percent of all possible intercorrelations. Considering the horizontal development within this level, reassuring support is again found. Communicative pointing is significantly related to language variables in 53 percent of the possible cases. Forty-four percent of all intercorrelations of the eight measures of communicative pointing are significant. Correlations between comprehension and language production are significant in 54 percent of all instances. The value of the correlations between comprehension measures and production measures reaches often the middle sixties and even the middle seventies, which means that comprehension predicts up to between 40 and 55 percent of the variance in language production.

The lower percentage of significant correlations between the items

on the level Meaning and Representation and language items is again in accordance with the general assumptions of Tables 1 and 2. Since the processes of Rote and Rule Learning are assumed to intervene between semantic and linguistic level, the ties between both would be expected to be less strong. That there exist important relationships is shown by the value of some of the significant correlations, which again reach the sixties. This is the case several times in respect to correlations between imitation and referential word use. That the range of around 10 to 35 percent of significant correlations is quite high is seen, when the frequencies of significant correlations between language variables and those measuring the level of Object Permanence, Spatial Relations, or Locomotion is considered. For these three categories the percentages of significant correlations range between 0 and 13, 4 and 15, respectively, and the percentage is 2 for locomotion.

One correlation pattern however was not expected according to the design represented in Tables 1 and 2. That is the relatively high percentage of significant correlations between the Means-Ends subscale of the Uzgiris-Hunt scales and language variables. Significant correlations between these two categories of behavior are equally frequent as those between symbolic play or imitation and language variables. Since means-ends acquisitions are hypothesized to be only quite indirectly related to language items in Tables 1 and 2, lower correlations were expected. This last correlation pattern supports more Buhler's (1934) and Skinner's (1957) hypothesis of the tool use of language and Moerk's (1978) factual report of the frequency with which speech is used instrumentally by child and mother. It is suggested that in this case a pragmatic aspect of mother-child interaction influenced the correlation pattern. The possi-

bility however must be left open that a logical reordering may be needed in the design of the tables as far as the importance of means-ends understanding for language is concerned.

In support of the functional hypotheses presented in the tables, Bates et al. report correlations between phenomena of imitation, the only process aspect measured in the Uzgiris and Hunt scales, as frequent and high. Symbolic play, a product of ludic assimilation, too was a good predictor of both gesture and language. This close relationship is to be expected, since all three behaviors involve some form of representation.

No other studies known to the writer present as extensive a correlation pattern as that of Bates et al. Single correlations and smaller patterns obtained by some investigators however are pertinent to the present hypotheses. In accordance with the argument presented above concerning the irrelevance of object permanence, Bates et al. (Note 5) and Corrigan (1978) have reported only small and generally insignificant correlations between the pertinent subscale from Uzgiris and Hunt and variables of language mastery. As expected, object permanence in the Piagetian sense however is important for statements about nonexistence and recurrence (cf. Corrigan, 1978). Zachry (Note 6) and Nicolich and Raph (in press) have reported statistically significant though complex and curvilinear ties between representational capacities and behavior on one side and the appearance of verbal imitation on the other. Folger and Leonard (in press) also found that the linguistically more advanced children were more prone to exhibit symbolic play, though most subjects in their single word utterance group did not exhibit symbolic play during their testing and observation sessions. Whether this should be taken as evidence for the multiple paths over which language can be acquired or whether it

is merely an artifact of the methodology employed, can at present not be decided. It has to be emphasized that the tables specify the first appearance of specific capacities, whereas Folger's and Leonard's measurements were taken in a new environment, wherein the behaviors had to be emitted within short time periods. How profoundly 'production deficiency' in such situations can distort the picture of the underlying capacities is broadly enough discussed in the field of intelligence testing. James and Eagen (Note 7) reported findings identical with those of Folger and Leonard, but they employed also an almost identical method. Their results can therefore not contribute to the solution of this question. A similar methodological problem casts grave doubts upon the data of Cook, Dale, & Goldstein (Note 8). In their study, the children were confronted with new toys in a new room and for part of the time in the company of an unknown person. In addition, they were provided only brief opportunities to engage in play with the objects. Since the situation would normally elicit first exploratory behavior it probably has interfered with the production of symbolic play. The design resulted therefore in a non-representative sample of the children's range of behaviors and in some implausible findings regarding the types of play engaged in, including a low level of symbolic play, as the authors themselves admit. The results seem therefore to be largely an artifact of a faulty methodology. This reservation is supported by the research of Hutt (1966), who found that children spend the first ten minutes of an encounter with a new toy solely in exploratory behavior and that they engage in free play only after around fifty to sixty minutes of acquaintance with this toy.

In respect to the importance of the function of imitation for symbolic

and language development, Carter (Note 3) reported for the sensorimotor period the precedence of imitative object naming over autonomous object naming. An apparently causal relationship between imitation and vocabulary acquisition was also reported by Nicolich & Raph (in press) and Moerk and Moerk (Note 9). For later stages, the studies by Bloom, Hood & Lightbown (1974) and by Moerk (1977a) have provided convincing evidence for the importance of imitation for language acquisition.

Close relationships between causal understanding as demonstrated in the discovery of means-ends relationships and the use of language as a tool have been reported by Bates et al. (Note 5), Folger and Leonard (in press), and Snyder (Note 10). This relationship, though intuitively making sense and being in accord with the overall hypotheses presented, is probably an indirect one, resulting from the overall advances in tool use. Since the functional value of vocal communication has been often experienced by the infant, an understanding of means-ends relationships would probably increase the use of language as a means. Yet, to understand that means can be used to achieve ends does not necessarily result in the knowledge of the means and of their application.

In a more general manner Dihoff and Chapman (1977) and Miller and Chapman (Note 11) have also reported close ties between advances on cognitive and linguistic levels. Zachry (Note 6) provides a concise summary of the first steps in language production and finds that at first names of things (nouns) are common, then follow action and state-of-being words (verbs), next come terms for attributes, followed by functors and other words. This sequence is identical with Stern and Stern's (1907) rank ordering, which in turn was supported by older studies. Even if these

sequences do not confirm directly the two outlines in Table 1 and 2, they certainly are in support of the general developmental principles suggested.

In addition to the more nomothetic findings presented above, it shall be attempted to evaluate the suggested developmental courses on the basis of idiographic longitudinal data. Ingram (in press) has abstracted the information from older baby biographies that is relevant to this goal. Since Ingram reports behaviors only, data about schemas and schemes and psychological processes can not be provided in Table 4.

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Insert Table 4 about here

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A few remarks about the data base have to precede the discussion and interpretation of the patterns apparent in Table 4. In one sense the data base is optimal, since it ranges in time from Preyer's (1895) very early record over Hogan (1898), Shinn (1900), and Piaget to the very recent study of Menn (Note 12). It also includes children from three cultures. The findings may therefore be more readily generalizable, if they reflect a clear pattern. On the other hand, the available evidence is sparse, it was collected on the basis of diverse perspectives and many of the antecedents of interest for the present hypotheses may not have been considered or not even been conceptualized by these investigators. The significance of missing evidence therefore can not be interpreted and only positive evidence can meaningfully be adduced in an attempt to evaluate the presented developmental hypotheses. For this evaluation, the most stringent criteria can be applied to sequential developments within the same vertical level. Concerning sequences across levels, more variability

has to be expected, since the processes affecting the transitions may have been quite unevenly supported in the families of the described children.

As far as factual evidence has been reported, within each level it appears in the same developmental sequence as suggested in Tables 1 and 2. This is to be expected in the case of Piaget's three children, since the tables were derived from his reports and theories. This agreement only shows that Ingram reads Piaget in the same manner as the writer. The independent evidence derived from the other four protocols however supports the suggested hypotheses more convincingly. The effects of processes and environmental variables seem to be reflected in minor advances or delays across the levels. This is seen quite clearly in the case of Piaget's three children. Jacqueline, the first child, is far advanced in her language development in relation to her cognitive level as compared to her two siblings. If the common finding holds also true for Piaget's home that first-born children enjoy more of the attention and input (verbal and nonverbal) of their parents than later-born ones, then this discrepancy between the children easily could be explained by the differential chance they had to engage in rote and rule learning of language skills due to differential input. Ingram (Note 13) reports a similar instance from a recent observational longitudinal study, in which one child was considerably advanced in her language abilities as compared to her cognitive level. Since all factors were well known in this case, Ingram could specify the cause for this acceleration: very advanced performance of the girl on the imitative level and especially in verbal imitations. This last finding would perfectly support the suggested process interpretation.

A delay in language production is encountered in the case of Axel Preyer, who progressed normally in his cognitive development and language comprehension. Preyer provides a pragmatic/interactional explanation for this delay, namely that the child had learned to communicate his messages very effectively and clearly on the nonverbal level.

Since Table 4 provides information about the contents observed, the ages of the children when they produced pertinent behavior, as well as the best estimate of the stage this behavior had to be attributed to, the developmental sequences for each child and for all of them together can be followed in the Table. In spite of some variations between the children, it appears that none of the recorded developments is in contrast to the suggested paths leading to verbal communicative skills. The number of subjects and the density of data points is too small to attempt statistical descriptions of these developmental courses, such as Green's (1956) index of consistency or reproducibility. Therefore, the evidence, though supportive, has to be considered as preliminary.

Summary and Discussion

This section will begin with more specific reflections about the preceding presentations that can be treated briefly and will conclude with more complex problems that will have to remain open challenges.

Though the last paragraph of the previous section ended on a positive note, it is certainly not implied that the two models presented are or will be supported in their totality. The models are seen as, hopefully challenging, guidelines for problem formulation and for improvements in research designs. It is even quite readily admitted that the tabular

presentation does not provide an optimal means to render the complex developmental phenomena. In accordance with Gesell's (1946) 'spiral reincorporation' and similar principles described by Werner and Kaplan (1963), or Flavell (1972) as 'spiral-like, cyclical, and recursive developmental processes' (p. 343), a spiral or a cylindrical representation would probably be more fitting. As conceptualized in a Piagetian perspective it would contain in the horizontal plane the two poles of the external world versus the internal structures of the organism as one dimension (the facts) and accommodation versus assimilation as the other polarity (the processes). On the vertical dimension the qualitative differences would be charted whereas the spiral course of development would reflect one aspect of horizontal decalage, the 'oblique' decalages as recently described by Inhelder et al. (1974). The polar dimension, that is described by assimilation and accommodation also would undergo vertical transformations, resulting in more complex, abstract, and representational ways of dealing with the environment, in a manner as Gagne (1968), Klausmeier, Ghatala, and Frayer (1974), and Staats (1971, 1974) have described the hierarchies of learning processes. Kendler & Kendler (1962) and Kendler (in press) have employed similar terms and conceptualizations in their extensive research program on 'vertical and horizontal processes in problem solving'. To learn a language is certainly a complex problem. This more encompassing conceptualization is presented in Figure 1.

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Insert Figure 1 about here

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As seen in Figure 1, development is hypothesized to begin with innate schemes which in interaction with the environmental 'aliments' lead to Perception and Behavior. Since practice always precedes the theory of it (Ryle, 1949), these functions lead to more elaborated cognitive schemas and schemes, which form the basis for Nonverbal Representation. Experience in representation provides the basis for communicative structures and rules, viz. the presently broadly discussed semantic base structures. Further environmental input in the form of language models makes possible the en- and decoding of the semantic structures in verbal form. Experience with a wide variety of verbal formulations enables the child to abstract linguistic/grammatical structures and rules. The latter can easily be recognized as underlying not only Aristotelian but also modern logic, that is, various metalanguages (cf. Lyons, 1977). Experience with the use of such a metalanguage could lead to the abstraction of new rules, and the spiral could continue upwards. These last developmental steps however are not of importance for the present discussion.

If drawn in cylindrical form, the walls of the model could be employed to list the behaviors and the internalized schemas and schemes, i.e., the products, and its interior for the description of a large variety of processes and transformations. Such a complex model however could not even be drawn with sufficient clarity and even less substantiated on the basis of factual studies.

Whereas the filling in of specific details has to be left for future research, it is hoped that the present essay contributes to research in at least three aspects: First, it provides a systematic outline of the continuity of development from perception/behavior to conception, meaning, and finally to verbal communication. It emphasizes developmental pro-

cesses and therewith transitions and continuities. In this way it can provide a starting point for the integration of process oriented research such as Gagne's (1968), Klausmeier's et al. (1974), Staat's (1971, 1974), and the recent work of the Piagetian school (Inhelder et al. 1974) with the more product oriented interests of linguists and developmental psycholinguists. A second productive development could be derived from the outline of a path model. Since this statistical approach employs the principle of regression analysis, some of the already established correlational data are relevant. Being simple in basic conceptualization, it can be quite readily evaluated through factual research. Because this path model emphasizes overdetermination and multiple pathways that can lead to the same products, it should also lead to a conceptual clarification of the possibility that tendency laws can be securely established and that exceptions in individual development would be the rule. Bertalanffy (1968) elaborated this same principle more extensively and termed it 'equifinality'. The third aspect that could contribute to new research approaches derives from the specification of two encompassing and common cognitive/communicative base structures, the Object-and-Attribute Frame and the Human-Action Frame. These two structures are certainly common in language and, if the present derivations are even approximately correct, their organic roots in the sensory and motor systems as well as their developmental transformations can be discerned and specified.

With this last proposal complex questions arise however, whose implications need further elaboration by scientists from various fields. On the one hand, considerable support appears to exist for such a basic twofold conceptualization of the world: Besides the clear distinction between sensory and motor systems, differences between perceptual learning, which

is predominantly S-S learning, and behavioral/motor learning, which is S-R or R-R learning have long been acknowledged. In addition, as mentioned with the introduction of this dichotomy, ancient precedents are found in philosophical and linguistic systems that persist up to the present, such as in Quine's (1973) emphasis upon 'observation sentences' (The apple is red) and 'eternal sentences' (A dog is an animal) on the one hand and the linguist's Chafe's (1970) emphasis upon the apparent priority of the patient and agent relations. Older psycholinguists such as Wundt (1900) and Buhler (1934) as well as present-day authors have emphasized a Human-Action Frame, though employing different terms. Ingram's (1971) discussion of transitivity and Taylor's (1976) comparison of transitive-based versus ergative-based structures pertain to similar phenomena. Regarding the Object-and-Attribute Frame, both Brown, Cazden, and Bellugi (1969) and Braine and Wells (1978) found that children treat the subject of deictic sentences and those of predicate adjectives as a category distinct from actor and functionally independent of objects of transitive verbs. In a cross-cultural perspective, Pike and Pike (1977) made a distinction very similar to the present one, when they describe two basic classes of clause roots, those reflecting transitivity and those reflecting what they call Identification (e.g., That is a table. A horse is a mammal.). They define however a third class: Existence (God exists), which is rare in English and appears late. Some of their state transitive clause roots (Pike & Pike, 1977, Display 7.5, p. 146) are however assigned in the present analysis to the Object-and-Attribute Frame, so that the concordance is not complete.

Whereas the postulate of two distinct basic frames is suggested by

these findings and conclusions, it is somewhat in contrast to the entrenched explanation of sentences as arguments and their predicates or topics and comments. The very early and basic sentence form: This is a ... (dog, ball, man, etc.) does not have a clear cut linguistic topic, or logical argument, especially if it appears as simple labeling, and its main function is logical predication. To be exact, it is multiple predication, since a label is mostly applied to an object after multiple features have been discerned, that is, predicated about it. The correctly applied label presumes therefore a wide variety of features. Equally, what is normally labeled an argument or topic of the sentence (The man is ..., The ball rolls) is, according to the present analysis, a multiple logical predication, that is, a result of multiple feature ascription. If something is 'predicated' linguistically about what is normally called an 'argument' or a 'subject', as in many complete propositions, it is merely an addition of a predication to a multiple predication, or an intersection or logical addition of classes. In this respect the suggested approach seems closer to Brentano (1874), who emphasized object identification as the most fundamental judgment, than to Whitehead's and Russell's (1910-1913) conception of a predicate with one or more variables. The topic-comment-form in which this multiple predication is often expressed is seen as due mainly to pragmatic/communicational exigencies, that is, it is an aspect of communicational but not of logical structure. Transitive sentences are conceived as too distinct to be included together with copula sentences under a general heading of predication. For the latter frame, Bruner's (1966) so-called language fundamental of causation, could seem somewhat more appropriate. Though when Bruner (1971, p. 335)

identifies his causation as a linguistic rendering of the cause-effect relationship, his assertion is not supported by evidence. Verb-Object structures normally render a process and an object-affected. To describe an effect one has to employ in many Indogermanic languages consecutive clauses, which are by far too complex for the young child and they therefore do not appear in early speech. A consideration of language examples and the argument presented in this essay suggest that mostly the verb is not expressing a cause either, at least if the term cause is understood in the physical sense. This is not astonishing, since the semantic base and the vocabulary of languages was shaped long before and independent of the modern physical thinking that is implied in the term causality. Research on infant attention (Kagan, 1970), early one-word sentences, and sparse linguistic evidence, which is mostly blurred by the effect of the Human-Action Frame, suggest that a process expression is the root of this frame. This can be a wish, when the infant says up in order to be picked up; an event, as most clearly seen in the Latin fulminat, pluit (it is lightening, it is raining); or an action in the common sense, as found in one-word expressions such as the infant's bye-bye, and eat. The adding of one or more aspects to this process description appears to be psychologically and logically quite different from the multiple predication of the Object-and-Attribute Frame. If object-and-attribute sentences are considered as multiple predications and the Human-Action Frame is accepted as profoundly different, then the linguistic search for one base structure for all sentences and its common analysis into subject and predicate constituents would have to be reconsidered. How case grammars and other theories about semantic base structures could be reconciled with the proposed two frames is another impor-

tant and open question.

With these last considerations, the discussion has arrived at complex and profound philosophical and linguistic implications of the proposed conceptualizations, whose evaluation will require a team of specialists from diverse fields of research.

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OBJECT-and-ATTRIBUTE FRAME: "This is X." "X is ...."

Developmental level	Stage 1(0-1) The use of reflexes	Stage 2(1-4) Primary circular reactions	Stage 3(4-8) Secondary circular reactions	Stage 4(8-12) Coordination of secondary schemas	Stage 5(12-18) Tertiary circular reactions	Stage 6(18-24) Mental combinations	Preoperational period (2-6 years)
	Horizontal Decalage						
Reference and Language			Comprehends referential gestures, object use as communication.	Comprehends single labels, produces referential gestures.	Labels objects, onomatopoetic words, comprehends brief phrases.	Noun-noun, noun-modifier constructions.	Increasingly nouns with modifiers, comprehends sign-character
			CONVENTIONAL-TRANSFORMATIONS-THROUGH-ROTE-AND-RULE-LEARNING				
Meaning and Representation		Response to single perceptual signals.	Gestural/ analogic object recognition.	Employment of mobile indices, anticipation, reconstruction.	Anticipation of object features, searching for missing objects.	Employing objects as signifiers in pretense play.	Increasing ludic symbolism.
			ANALOGIC-TRANSFORMATIONS-THROUGH-ACCOMMODATIVE-IMITATION-AND-RECOGNITORY-PLUS-LUDIC-ASSIMILATION				
Schemas and Schemes	Substance	Object, X (only as phenomenon not yet entity; set only) + features.	Object, X (set) + members of set: x_1, x_2, x_3.....	Objects with several features, in spatial relationships.	Relations between features, intension of each object defined.	Relations between objects based upon various features.	Hierarchic classification core vs. incidental features.
			IDIOSYNCRATIC-TRANSFORMATIONS-THROUGH-SIMPLE-OR-REFLECTIVE-ABSTRACTION				
Perception and Behavior	Grasping, sucking, eyeblink, orienting reflex.	Coordination between schemas such as prehension and sucking.	Procedures for making interesting sights last.	Exploration of new objects; objects as means.	Pursuit of the novel, elaboration of the object concept.	Object features employed to solve practical problems.	Increasing mastery over world of objects.
			ASSIMILATION-AND-ACCOMMODATION				

Vertical Decalage

The HUMAN-ACTION FRAME: "X affects Y", "X acts."

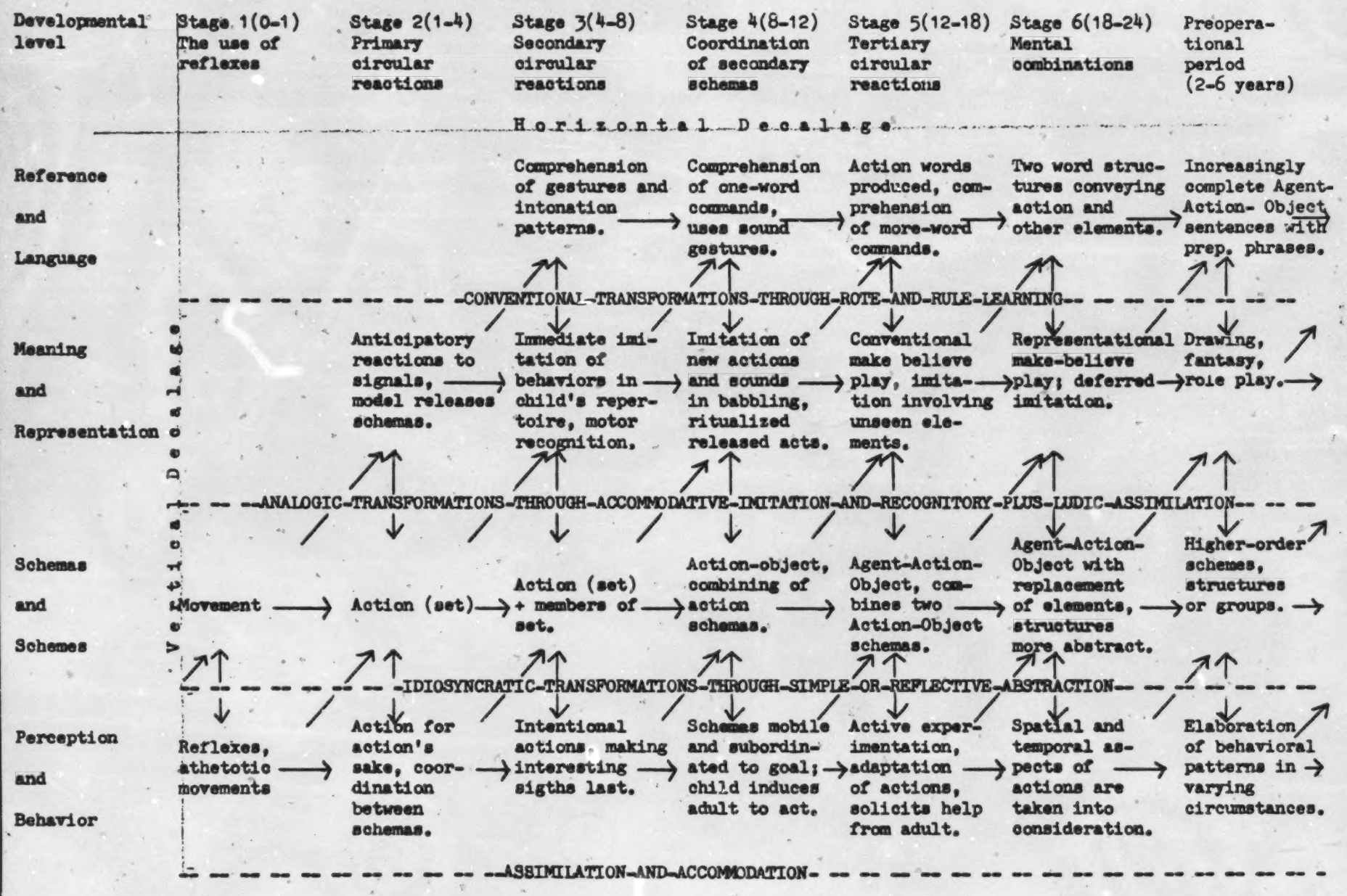

Developmental level
Stage 1(0-1) The use of reflexes
Stage 2(1-4) Primary circular reactions
Stage 3(4-8) Secondary circular reactions
Stage 4(8-12) Coordination of secondary schemas
Stage 5(12-18) Tertiary circular reactions
Stage 6(18-24) Mental combinations
Preoperational period (2-6 years)
Horizontal Decalage
Vertical Decalage
Reference and Language
Comprehension of gestures and intonation patterns.
Comprehension of one-word commands, uses sound gestures.
Action words produced, comprehension of more-word commands.
Two word structures conveying action and other elements.
Increasingly complete Agent-Action- Object sentences with prep. phrases.
CONVENTIONAL-TRANSFORMATIONS-THROUGH-ROTE-AND-RULE-LEARNING
Meaning and Representation
Anticipatory reactions to signals, model releases schemas.
Immediate imitation of behaviors in child's repertoire, motor recognition.
Imitation of new actions and sounds in babbling, ritualized released acts.
Conventional make believe play, imitation involving unseen elements.
Representational make-believe play; deferred imitation.
Drawing, fantasy, role play.
ANALOGIC-TRANSFORMATIONS-THROUGH-ACCOMMODATIVE-IMITATION-AND-RECOGNITORY-PLUS-LUDIC-ASSIMILATION
Schemas and Schemes
Movement
Action (set)
Action (set) + members of set.
Action-object, combining of action schemas.
Agent-Action-Object, combines two Action-Object schemas.
Agent-Action-Object with replacement of elements, structures more abstract.
Higher-order schemes, structures or groups.
IDIOSYNCRATIC-TRANSFORMATIONS-THROUGH-SIMPLE-OR-REFLECTIVE-ABSTRACTION
Perception and Behavior
Reflexes, athetotic movements
Action for action's sake, coordination between schemas.
Intentional actions, making interesting sigths last.
Schemes mobile and subordinated to goal; child induces adult to act.
Active experimentation, adaptation of actions, solicits help from adult.
Spatial and temporal aspects of actions are taken into consideration.
Elaboration of behavioral patterns in varying circumstances.
ASSIMILATION-AND-ACCOMMODATION

Table 3

Correlation patterns between a subset of the cells presented in Tables 1 and 2.

	Overall language (9 measures)	Language production labeling (referential)	Language production action words (non-referential)	Language comprehension	Communicative pointing (8 measures)
Overall language (9 measures)	44%				
Language production labeling (referential)				43% 1.	
Language production action words (non-referential)				48% 1.	
Language comprehension				54% 1.	
Communicative pointing (8 measures)	53%				44%
Symbolic play	19%	21%	22%	13%	34%
Imitation U - H Scale	17%	21%	21%	8%	18%
Means-Ends U - H Scale	20%	25%	21%	13%	26%

1. This symbol signifies that the correlations were computed between the variable to the left of the row and the sum of the two variables in the columns in which the arrows are ending.

Table 4

Longitudinal evidence of cognitive/communicational development.

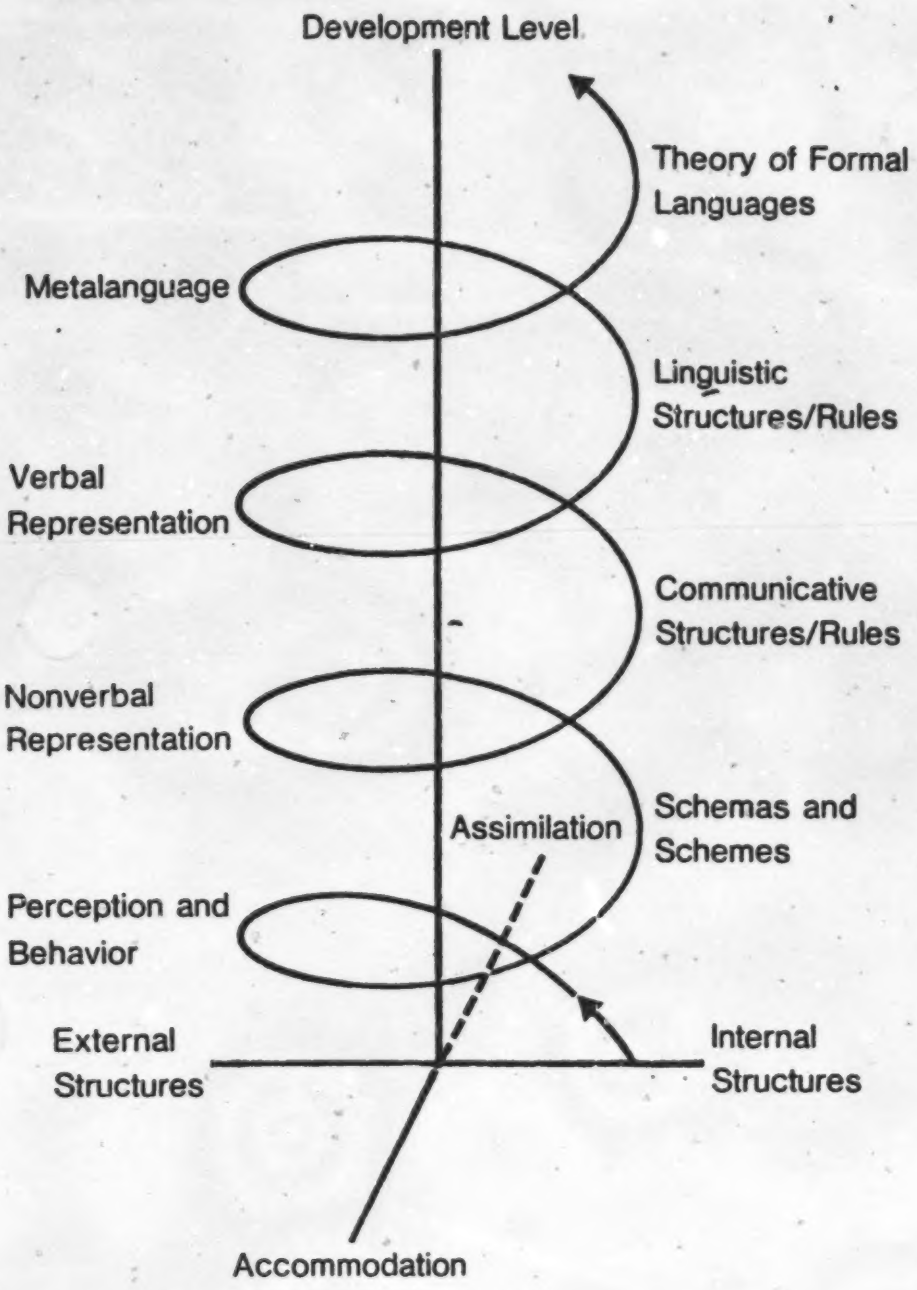
	Stage 3		Stage 4		Stage 5		Stage 6	
Reference and Language			Luc.	1;3 referential gestures	Jac.	1;1 onomatopoetic words + labels	Jac.	1;7½ 2-word struc.
					Luc.	1;3 comprehends phrases 1;3½ labels		
					Laur.	1;2 labels; action words; comprehends phrases		
			R.S.	0;10 referential gestures + sound gestures	R.S.	0;10 action words 0;11 7 words; comprehends phrases		
					H.H.	0;9-1;2 labels; onomatopoetic words + action words + comprehends phrases	H.H.	1;6 2-word structures + 50 words
			A.P.	1;1 comprehends several words	A.P.	1;1 action word; comprehends 50 words + phrases	A.P.	1;4 33 words
			J.M.	1;1 6 'proto-words'	J.M.	1;2 action words; 1-5 labels	J.M.	1;5 2-wd. str. + 14 words
Meaning and Representation	Jac.	0;8 imitation 0;11 imitation	Jac.	1;3½ imitation of meaningful sounds	Jac.	1;2 make believe play	Jac.	1;4 deferred imit.; make believe play
	Luc.	1;0 imitation	Luc.	1;0 imitation	Luc.	1;0 make believe play; imitates unseen elements		
					H.H.	1;2 make believe play		
					A.P.	1;2 make believe play; searches missing onject; imitates unseen elements	A.P.	1;5 complex make-believe play
Perception and Behavior			Luc.	1;0 induces adult to act; means				
			Laur.	0;10 explores new obj.				
			R.S.	0;7 0;8 means + expl.				
			H.H.	1;2 means	H.H.	1;2 experimentation		
			A.P.	1;2 induces adult to act	A.P.	1;1 experimentation	A.P.	1;4 object used to solve practical prob
			J.M.	1;1 U - H Scales	J.M.	1;2 U - H Scales	J.M.	1;4 U - H Scales

Jac. =Jacqueline Piaget
Luc. =Lucienne Piaget
Laur. =Laurent Piaget
R.S.= Ruth Shinn
H.H.= Harold Hogan
A.P.= Axel Preyer
J.M.= Jacob Mann
U - H Scales=Uzgiris-Hunt Scales

1. The ages are given in years and months (1;9), rounded up or down to the nearest full month. Only in the case of 13-17 days between full months is ½ added to the two numbers.

Figure Caption

Figure 1. A more complete model of the development of language mastery.


Development Level
Theory of Formal Languages
Metalanguage
Linguistic Structures/Rules
Verbal Representation
Communicative Structures/Rules
Nonverbal Representation
Schemas and Schemes
Assimilation
Perception and Behavior
External Structures
Internal Structures
Accommodation